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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/608,347	06/27/2003	Chin-Tien Yang	TSM02-1234	8752

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EXAMINER	
PERKINS, PAMELA E	
ART UNIT	**PAPER NUMBER**
2822	

DATE MAILED: 06/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/608,347	YANG ET AL.	
	Examiner	Art Unit	
	Pamela E. Perkins	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 March 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-10 and 21-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10 and 21-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *3/25/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the filing of the amendment on 25 March 2005. Claims 1-10 and 21-32 are pending.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-7. 10, 21-23, 25-29, 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park (5,930,670) in view of Lu (6,239,010).

Referring to claims 1, 21, 22, 27 and 28, Park discloses a method of fabricating a contact plug where a substrate (21) has a lower portion and a layer of selected material (24) over the lower portion, the selected material (24) having a top surface; defining an aperture (20) in the selected material (24) extending from the top surface toward the lower portion; depositing a layer of tungsten (26) over the top surface of the layer of selected material (24), the tungsten (26) also filling the aperture (20); etching the tungsten layer (26) to remove a top portion of the tungsten layer (26); stopping the etching so as to leave a reduced thickness of the tungsten layer (26) adjacent to the aperture (20) so that the tungsten layer (26) is not separated form a bottom of the aperture (20) during the etching (Fig. 3B); and providing a contact area (27) over at

least a portion of the tungsten (26) filled aperture (20), wherein the contact area (27) in electrical contact with the tungsten (26) filling the trench (20). Park further discloses removing at least part of the reduced thickness portion of the metal/tungsten layer (26) during the forming of the contact pad (27) (Fig. 3C; col. 4, lines 51-60).

Park does not disclose polishing the tungsten layer.

Lu discloses a method of fabricating a contact plug where a substrate (200) has a lower portion and a layer of selected material (216) over the lower portion, the selected material (216) having a top surface (Fig. 2B; col. 3, lines 27-56); defining an aperture (228) in the selected material (216) extending from the top surface toward the lower portion; depositing a layer of metal (230) over the top surface of the layer of selected material (216), the metal (230) also filling the aperture (228) (Fig. 2E; col. 4, lines 8-31); polishing the metal layer (230) to remove a top portion of the metal layer (230); stopping the polishing so as to leave a reduced thickness of the metal layer (230a); and providing a contact area (232a) over at least a portion of the metal (230a) filled aperture (228), the contact area (232a) in electrical contact with the metal (230a) filling the aperture (228) (Fig. 2G; col. 4, lines 32-50).

Since Park and Lu are both from the same field of endeavor, a method of fabricating a contact plug, the purpose disclosed by Lu would have been recognized in the pertinent art of Park. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Park by polishing the metal layer as taught by Lu to increase efficiency and device integration (col. 2, lines 1-9).

Referring to claim 2, Park discloses the aperture as a trench (col. 4, lines 29-34).

Referring to claims 3 and 26, Park discloses the substrate (21) including a conductive area (23) covered by the layer of selected material (24) and wherein the aperture (20) is a via extending through the layer of selected material (24) and the tungsten (26) in the via is in electrical contact with the conductive area (23) (col. 4, lines 22-60).

Referring to claims 5, 25 and 31, Park discloses the layer of selected material (24) is one of a layer of a dielectric material and a layer of insulating material (col. 4, lines 22-39).

Referring to claims 6 and 32, Park discloses depositing a liner material (16) in the aperture (15) and over the top surface of the selected material (14) before depositing the layer of tungsten (18) (col. 3, lines 22-62).

Referring to claim 7, Lu discloses the contact area (232a) is made of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum (col. 4, lines 40-43).

Referring to claim 10, Lu discloses a liner material (226a) is selected from the group consisting of tantalum, tantalum nitride, titanium and titanium nitride (col. 4, lines 17-19).

Referring to claims 4, 23 and 29, Park discloses reduced layer of tungsten remaining after polishing is between 500 and 1000 Å (col. 4, lines 40-50). It is noted that the specification contains no disclosure of either the critical nature of the claimed concentrations of any unexpected results arising there from. It would have been obvious to one of ordinary skill in the art to form reduced layer of tungsten remaining

after polishing is between 0.3 μm and 0.01 μm since it has been held that "In such an situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) See MPEP § 2144.05.

Claims 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park in view of Lu as applied to claim 1 above, and further in view of Kobayashi (6,610,597).

Park in view of Lu disclose the subject matter claimed above except making the conductive area of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum.

Kobayashi discloses a method of fabricating a tungsten plug where a substrate (007) has a lower portion and a layer of selected material (008) over the lower portion, the selected material (008) having a top surface; defining a trench (021) in the selected material (008) extending from the top surface toward the lower portion; depositing a liner material (003) in the trench and over the top surface of the selected material (008); depositing a layer of tungsten (005) over the top surface of the layer of selected material (008), the tungsten also filling the trench (021); etching the tungsten layer (005) to remove a top portion of the tungsten layer (005); and providing a contact area (010) over at least a portion of the tungsten (005) filled trench (021), wherein the contact area (010) in electrical contact with the tungsten (005) filling trench (021). Kobayashi further discloses the substrate (007) including a conductive area (009) covered by the layer of

selected material (008) and wherein the trench (021) is a via extending through the layer of selected material (008) and the tungsten (005) in the via is in electrical contact with the conductive area (009) (col. 10, line 19 thru col. 11, line 67).

Referring to claim 8, Kobayashi discloses making the conductive area (009) of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum (col. 10, lines 19-26).

Since Park and Kobayashi are both from the same field of endeavor, a method of fabricating a tungsten plug, the purpose disclosed by Kobayashi would have been recognized in the pertinent art of Park. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Park by making the conductive area of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum as taught by Kobayashi to prevent plug loss (col. 12,lines 1-7).

Referring to claim 9, Lu discloses the contact area (232a) is made of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum (col. 4, lines 40-43).

Claims 24 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park in view of Lu as applied to claims 21 and 27 above, and further in view of Matsubara et al. (6,268,090).

Park in view of Lu disclose the subject matter claimed above except a wafer having a diameter of more than 200 mm.

Matsubara et al. disclose a method of fabricating a contact plug where a substrate (101) has a lower portion and a layer of selected material (104) over the lower portion, the selected material (104) having a top surface; defining a trench in the selected material (104) extending from the top surface toward the lower portion (Fig. 2B; col. 3, lines 50-62); depositing a liner material (105) in the trench and over the top surface of the selected material (104) (Fig. 2C; col. 3, lines 5-12); depositing a layer of metal (109) over the top surface of the layer of selected material (104), the metal also filling the trench (Fig. 3A); and polishing the metal layer (109) to remove a top portion of the metal layer (109) (Fig. 3B; col. 4, lines 13-21).

Referring to claims 24 and 30, Matsubara et al. disclose a wafer (1) having a diameter greater than 200 mm (col. 1, lines 26-34).

Since Park and Matsubara et al. are both from the same field of endeavor, a method of fabricating a contact plug, the purpose disclosed by Matsubara et al. would have been recognized in the pertinent art of Park. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Park by the wafer having a diameter of more than 200 mm as taught by Matsubara et al. to prevent peeling (col. 47-56).

Response to Arguments

Applicant's arguments filed 25 March 2005 have been fully considered but they are not persuasive. As stated above, Park in view of Lu disclose the method of

reducing the circuit failure caused by tungsten plug pulling out of an apparatus as described in independent claims 1, 21 and 27.

In response to the applicant's arguments, the applicant argues prior art does not disclose polishing a top portion of the tungsten layer. However, Lu discloses polishing a metal layer (230) to remove a top portion of the metal layer (230); and stopping the polishing so as to leave a reduced thickness of the metal layer (230a) (Fig. 2G; col. 4, lines 32-50).

Applicant also argues prior art does not disclose stopping a polishing so as to leave a reduced thickness of the tungsten layer adjacent to the aperture so that the tungsten layer is not separated form a bottom of the aperture during the polishing. However, Park in view of Lu disclose stopping the polishing so as to leave a reduced thickness of the tungsten layer adjacent to the aperture so that the tungsten layer is not separated form a bottom of the aperture during the polishing.

In response to Applicant's argument that there is no suggestion to combine the references, the Examiner recognizes that references cannot be arbitrarily combined and that there must be some reason why one skilled I the art would be motivated to make the proposed combination of primary and secondary references. *In re Nomiya*, 184 USPQ 607 (CCPA 1975). However, there is no requirement that a motivation to make the modification be expressly articulated. The test for combining references is what the combination of disclosures taken, as a whole would suggest to one of ordinary skill in the art. *In re McLaughlin*, 170 USPQ 209 (CCPA 1071). References are evaluated by what they suggest to one versed in the art, rather than by their specific disclosures. *In*

re Bozek, 163 USPQ 545 (CCPA 1969). In this case, it obvious to polish the tungsten layer to remove a top portion of the tungsten to increase efficiency and device integration (Lu: col. 2, lines 1-9).

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E. Perkins whose telephone number is (571) 272-1840. The examiner can normally be reached on Monday thru Friday, 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

PEP

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